Cryptogams on granites

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Abstract

Cryptogams (lichens, fungi, mosses, liverworts and algae) are a vital part of the biodiversity of granite outcrops, yet are not well known. As with all groups of organisms, there are both common and rare species of cryptogams. Most cryptogams are vulnerable to disturbance, even human footprints. Proposals for research and conservation of cryptogams are presented.

Keywords: cryptogam, granite outcrop, mosses, liverworts, fungi, lichens, algae

Introduction

Cryptogams are small organisms that we tend to walk over and ignore, or not even see, as we traverse granite outcrops, or, for that matter, most habitats. Cryptogams are seldom so conspicuous as to excite great excitement. The name is from the Greek *cryptos* (covered, hidden) and *gamos* (marriage), in reference to the concealed nature of their sexual reproduction.

This paper is really a story of ignorance. My aim is not to present a highly scientific account of these fascinating organisms, or a mass of names and figures about them; rather it is to raise awareness of them. Indeed, there is probably no specialist in Australia, in any group of cryptogams, who could do so for the granite outcrops of south-western Australia. I shall return to this point, the almost total lack of researchers in cryptogams in this region.

First, I want to explain each group of cryptogams, then discuss research needs and conservation. You will see that we are at a very early stage in knowing what we have and how they live, probably equivalent to the knowledge of flowering plants a hundred or more years ago.

Cryptogams

Two groups of cryptogams are collectively called bryophytes; these are the mosses (which most of us at least recognise, even if we don't know their names) and the liverworts, which are much less conspicuous. Fungi are now considered to belong to one or more separate kingdoms, rather than included with plants. Lichens are intriguing mutual associations of fungi and algae or cyanobacteria. Algae, which include seaweeds and water blooms, also form large colonies on rock faces, on surrounding soil, or in pools.

Mosses

Mosses are small plants with separate generations, one the gametophyte (a leafy haploid phase, the commonly seen stage) and a diploid sporophyte that produces spores. The latter is relatively short-lived and less often noticed. Mosses have stems (usually with water-conducting strands) but no roots; rather they have root-like structures called rhizoids. Growth is from an apical cell. Sexual reproduction involves the production of male sperm cells in antheridia and eggs in archegonia. Following fertilisation, a sporophyte is formed, commonly on a stalk with a capsule at its apex. Here the haploid spores develop and are eventually released, controlled by a complex structure around the mouth of the capsule.

Perennial mosses survive desiccation by drying out, curling up and lying dormant until moisture improves. Ephemeral species have a short life span and survive as spores.

A moss, *Pleurophascum occidentale*, is the only cryptogam in the State that is Declared Rare Flora. A moss of uncertain classification as its fertile capsular stage has never been seen, it grows in exposed soil pockets at the edge of granite rock at Two Peoples Bay. Any change to its moisture regime will threaten its survival.

Liverworts

Most liverworts associated with granite rocks are on the soil aprons overlying or adjacent to rocks. They are thallose, most being more or less flat, close-pressed to the soil and attached to the substrate by rhizoids. A few are leafy and appear moss-like. Reproduction is commonly vegetative, by means of break up of a thallus, or production of groups of cells called gemmae that break away and develop into new plants. Like mosses, liverworts are poikilohydric *i.e.* they are resurrection plants with the ability to become dormant in unfavourable conditions (usually lack of moisture) but resume growth when conditions improve. In contrast to mosses they lack stomata and have no specialised conducting tissue.

Fungi

Fungi are now considered to belong to one or more separate kingdoms, rather than included with plants. They lack chlorophyll, have no vascular system, and reproduce by spores. The larger (or macro-) fungi include forms well-known to all as mushrooms and toadstools, cup fungi and stinkhorns. That part of a fungus is its fruiting body and is the only part readily visible. The 'vegetative' part is a mass of slender threads known as mycelium, usually hidden in soil, on rotting wood, plant stems or leaves etc. The fruiting bodies are not produced every year, hence years of survey are required if a complete inventory of even larger fungi is to be obtained.

The microscopic fungi are scarcely known. It is estimated that there may be as many as 250 000 species of fungi in Australia; only some 5% are currently known.

Fungi are absolutely crucial to the survival and well-being of all other life on earth. It is said that other groups of organisms could disappear and other life would continue, but if the fungi were to go then life as we know it would also disappear. They provide us with food and pathogens, they include yeasts, and they are widely involved in decomposition.

Lichens

Lichens are intriguing mutual associations of fungi and algae or cyanobacteria. For nomenclatural purposes they are classed as fungi, but researchers tend to specialise in lichens or fungi. Having an algal component with chlorophyll they are able to manufacture their own food. Presumably the fungus obtains carbohydrates from the alga, and in return the alga receives nutrients absorbed from the substrate and protection. The cup-like fruiting bodies that we see represent only the fungal component, which grows and reproduces just as an ascomycete fungus. As far as I know, no-one has yet discovered how the algal component reproduces, nor how the alga and fungus come together to form a new lichen plant.

Lichens grow on soil, rock surfaces, bark and sometimes leaves, though the latter not in Western Australia as far as I am aware. Those on otherwise bare granite rocks tend to escape fire as there is no adequate fuel to carry fire across them, but I have seen one instance (Wattengutten Hill) of an extremely hot summer fire on a strong wind scorching all lichens from the surface. I have never had the opportunity to return to the site to see what recolonisation has occurred.

As an indication of our poor knowledge I would cite two species (*Neofuscelia subbarbatica, Xanthoparmelia nana*) each known from one granite rock in the hills east of Perth, and two (*Paraparmelia sammyi, Paraparmelia sargentii*) known only from Yillimining Rock east of Narrogin. Indeed, Yilliminning Rock is the only rock for which even a preliminary list of cryptogams is available, and that of lichens only (33 species, Piggott & Sage 1997).

Either these species are more widespread, or there are likely to be many more species of very restricted range out there awaiting discovery and classification.

Algae

Probably everyone knows some algae, if not by that term. They include seaweeds and water blooms (an odd term, given that they do not have flowers), and if you have ever slipped on a rock in a stream or a damp path the odds are that algal growth caused the slipperiness. They also include diatoms, desmids and other phytoplankton, microscopic algae that are the basis of the food chain. It has been said that without algae, all bodies of freshwater would effectively be dead. We tend not to associate algae with granite rocks or with the soil surface. Those of granite rocks are very small but may form large colonies on rock faces, on surrounding soil, or in pools.

One of the most recent publications on freshwater algae in Australia (Entwistle *et al.* 1997) states, very bluntly, that those on rocks have been 'little studied in Australia' and on soil are 'largely unknown'. It is an indictment of our failure to study them in this State that this recent reference includes very few records from here. They are important in colonising soil and rocks after extreme disturbance such as fire, though we have no data on how they do this. They stabilise loose soil, provide food and, in pools, shelter.

Chara and *Nitella* are two genera of algae with a readily recognisable plant form that occur on pools and slow-flowing streams.

Conservation

A goal of the 'National strategy for the Conservation of Australia's Biodiversity' is the protection of that biodiversity and the maintenance of ecological processes and systems; yet the resources to discover huge sections of that biodiversity have still not been made available. In Western Australia, the 'Wildlife Protection Act' at least has been amended so as to specifically cover cryptogams as well as vascular plants; but so far only the moss *Pleurophascum occidentale* is declared as rare, while two fungi, twenty-one lichens and three other mosses are listed as Poorly Known. I suspect these numbers should be much larger. All other cryptogams therefore are incidentally conserved when they occur in areas reserved for other organisms or purposes. In the short term, until we learn more about them, habitat conservation is the only way to go, but without inventories of what is present we have no way of knowing what percentage of cryptogams we are preserving in this way.

From left to right: Peak Charles, a high granitic dome (650 m) in a semi-arid zone, with bands of a freshwater alga; Bands of a freshwater alga on Mt Churchman, a large granitic rock in an arid zone; Mosses (*Campylopus, Brutelia*) and lichen on Shannon Rock, a granitic slope in a high-rainfall zone; Moss (*Grimmia*) in its dormant state on Billyacatting Hill, a low granitic dome in a semi-arid zone; The lichen *Siphula coriacea* among mosses and sundews (*Drosera*). Photographs by AS George

As George Scott has written, 'estimates of rarity are, with some exceptions, merely confession of ignorance' (Scott *et al.* 1997). That ignorance covers taxonomic knowledge, classifications for rarity that are inadequate for cryptogams (it is virtually impossible to count individual plants of bryophytes, lichens and many fungi, hence another measure of abundance is required), and understanding of the organisms (for example, just because a fungus does not produce a fruiting body does not mean that it is not there).

Management

Because cryptogams are small and commonly fragile they are susceptible in the extreme to physical disturbance. Even soft-soled shoes can damage them, and anything heavier such as vehicle tires can obliterate them. And we have no idea how these organisms respond to fire. The retaining walls already built on a number of rocks for water catchment would have changed the water regime both immediately above the wall and downslope of it, resulting in changes that we can only guess at because of our ignorance. There would also be a change in light intensity in the microhabitats along the 'down-sun' side of such walls. They can also be highly sensitive to atmospheric pollution such as vehicle and industrial exhaust fumes.

Recommendations

I can hardly do more than repeat those of Scott *et al.* (1997):

1. The most urgent need is skilled workers. The Western Australian Herbarium (Department of Conservation and Land Management) has never had any staff specialising in these groups. There is a small collection, mainly of lichens and mosses, currently maintained by a volunteer. Many species recorded for the State are unrepresented in the collection. The only systematic work is by specialists in other States and overseas.

   In Western Australia, we have no lichenologist, no bryologist, no freshwater phycologist except on those of economic importance and Jacob Johns, Curtin University (on diatoms). We have one mycologist studying macrofungi, and several on species important in silviculture and agriculture.

   In a submission to the latest 'State of the Environment' report I drew attention to the need to increase the taxonomic effort on cryptogams. The response was to agree but refer it to the relevant agency, presumably the Western Australian Herbarium. To my suggestion that specialist cryptogamic botanists be appointed the response was even weaker—'this is beyond the scope of this report.' I suspect this means that there will be no change to the current zero level of research.

2. A second, vital need is adequate collections on which a sound taxonomy can be established. This will tell us what we have and how it relates to the rest of the country and the world (many of these organisms are far more widespread than are our flowering plants).
3. Next, we need geographical and ecological data so that we can learn where and how to conserve them, whether more reserves are needed.
4. A comprehensive database with national and international links should be established. This is especially important given that a number of species recorded for the State are not represented in our collections.
5. Public awareness of crytogams should be raised through publications, lectures, posters, resource kits for schools etc.
6. Land managers should be trained so that they may be aware of cryptogams, their nature and their needs.
7. Research should be undertaken into potentially useful cryptogams.
8. Throughout Australia, appropriate, uniform legislation should be set up for protection of crytpogams.

References

Bibby P & Smith G G 1955 4.— A list of lichens of Western Australia. Journal of the Royal Society of Western Australia 39:28-29.

Bougher N L & Syme K 1998 Fungi of Southern Australia. University of Western Australia Press, Nedlands.

Catcheside D G 1980 Mosses of South Australia. Handbooks Committee, South Australian Government, Adelaide.

Eldridge D & Tozer M E 1997 A practical guide to Soil Lichens and Bryophytes of Australia's Dry Country. Department of Land and Water Conservation, Sydney.

Entwisle T J, Sonneman J A & Lewis S H 1997 Freshwater Algae in Australia. Sainty and Associates, Potts Point.

Filson R B & Rodgers R W 1979 Lichens of South Australia. Handbooks Committee, South Australian Government, Adelaide.

George A S (ed.) 1992 Flora of Australia Vol. 54 Lichens — Introduction, Lecanorales 1. AGPS Press, Canberra.

Griffiths K 1985 A Field Guide to the Larger Fungi of the Darling Scarp & South West of Western Australia. Privately published, Perth.

Hilton R N 1982 A census of the larger fungi of Western Australia Journal of the Royal Society of Western Australia 65:1-15.

Hilton R N 1988 A census of the larger fungi of Western Australia Part II. Journal of the Royal Society of Western Australia 70:111-118.

Orchard A E (ed.) 1996 Fungi of Australia Vol. 1A, Introduction—Classification. ABRS and CSIRO, Canberra.

Orchard A E (ed.) 1996 Fungi of Australia Vol. 1B, Introduction—Fungi in the Environment. ABRS and CSIRO, Canberra.

Piggott J W & Sage L W 1997 Remnant vegetation, priority flora and weed invasions at Yilliminning Rock, Narrogin, Western Australia. Journal of the Royal Society of Western Australia 80:201-208.

Sammy N C & Smith G G 1974 6.— An annotated list of lichens from the coastal limestone near Perth, Western Australia. Journal of the Royal Society of Western Australia 57:38-42.

Scott G A M 1985 Southern Australian Liverworts. Australian Flora and Fauna Series No. 2. AGPS, Canberra.

Scott G A M and Stone I G 1976 The Mosses of Southern Australia. Academic Press, London.

Scott G A M, Entwisle T, May T & Stevens N 1997 A Conservation Overview of Australian Non-marine Lichens, Bryophytes, Algae and Fungi. Wildlife Australia, Canberra.